AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A percutaneous cannula for discharging blood within a patient's vasculature, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough; and

a tip portion extending from the main cannula portion to a distal end of the cannula, the tip portion comprising:

a discharge opening; and

a redirecting member **comprising an expandable member configured to expand under the pressure of the blood flow directed through the discharge opening, the redirecting member** configured to direct blood flow being discharged through the discharge opening proximally along the cannula.

2. (Canceled)

3. (Original) The cannula of Claim 1, wherein the redirecting member is collapsible to cover the discharge opening during insertion.

4. (Original) The cannula of Claim 3, wherein the redirecting member is collapsible to partially cover the discharge opening during insertion.

5. (Original) The cannula of Claim 1, wherein the redirecting member is actuatable to a pre-defined shape.

6. (Original) The cannula of Claim 1, wherein the tip portion comprises a plurality of discharge openings.

7. (Original) The cannula of Claim 6, wherein the tip portion further comprises a plurality of redirecting members configured to direct blood flow being discharged through the discharge openings proximally along the cannula.

8. (Original) The cannula of Claim 6, wherein the discharge openings are uniformly spaced radially around the tip portion.

9. (Original) The cannula of Claim 6, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

10. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates; and

the cannula of Claim 9 fluidly linking the pump to the patient's vasculature.

11. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates;

an inflow conduit fluidly coupled to the pump and configured to direct blood to the pump from a first vascular site; and

the cannula of Claim 1 fluidly linking the pump to a second vascular site.

12. (Original) The cannula of Claim 1, wherein the cannula further comprises a tapered portion proximate the distal end of the cannula.

13. (Original) The cannula of Claim 1, further comprising a surface extending across the blood flow lumen, the surface configured to direct blood through the discharge opening.

14. (Original) The cannula of Claim 13, wherein a guidewire lumen extends between the surface and the distal end.

15. (Original) The cannula of Claim 14, further comprising sealing means configured to minimize the blood flow through the guidewire lumen when the cannula is in operation.

16. (Original) The cannula of Claim 15, further comprising a valve located in the guidewire lumen.

17. (Original) The cannula of Claim 15, further comprising a plug located in the guidewire lumen.

18. (Original) The cannula of Claim 1, further comprising a recess at the distal end of the cannula and configured to receive a guide-member.

19. (Original) The cannula of Claim 18, further comprising a guide-member embedded in the recess.

20. (Original) The cannula of Claim 19, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

21. (Original) The cannula of Claim 1, further comprising a gap extending between a proximal edge of the redirecting member and a proximal edge of the discharge opening through which blood may flow.

22. (Original) A percutaneous cannula for discharging blood within a patient's vasculature, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough;

a discharge opening; and

a transition portion extending distally from the main cannula portion and having a lumen therethrough, the transition portion configured to engage an adjacent wall of a blood vessel to space the discharge opening of the cannula from the adjacent wall of the blood vessel so as to substantially reduce blood discharging from the blood flow lumen through the opening from directly impacting upon said blood vessel wall.

23. (Original) The cannula of Claim 22, further comprising a tip portion comprising the discharge opening, the tip portion configured to permit the discharge of blood through the discharge opening in a direction generally counter to the direction of flow through the lumen in the main cannula portion.

24. (Original) The cannula of Claim 23, wherein the tip portion extends between the transition portion and the distal end of the cannula.

25. (Original) The cannula of Claim 22, further comprising a redirecting member configured to direct blood flow being discharged through the discharge opening proximally along the cannula.

26. (Original) The cannula of Claim 25, wherein the redirecting member comprises an expandable member configured to expand under the pressure of the blood flow directed through the discharge opening.

27. (Original) The cannula of Claim 22, wherein the redirecting member is collapsible to cover the discharge opening during insertion.

28. (Original) The cannula of Claim 27, wherein the redirecting member is collapsible to partially cover the discharge opening during insertion.

29. (Original) The cannula of Claim 22, wherein the redirecting member is actuatable to a pre-defined shape.

30. (Original) The cannula of Claim 22, further comprising a plurality of discharge openings.

31. (Original) The cannula of Claim 30, further comprising a plurality of redirecting members configured to direct blood flow being discharged through the discharge openings proximally along the cannula.

32. (Original) The cannula of Claim 30, further comprising a surface extending across the blood flow lumen, the surface configured to direct blood flow through the discharge openings.

33. (Original) The cannula of Claim 32, wherein a guidewire lumen extends between the surface and the distal end of the cannula.

34. (Original) The cannula of Claim 33, further comprising sealing means configured to minimize the flow of blood through the guidewire lumen when the cannula is in operation.

35. (Original) The cannula of Claim 34, further comprising a valve located in the guidewire lumen.

36. (Original) The cannula of Claim 34, further comprising a plug located in the guidewire lumen.

37. (Original) The cannula of Claim 22, wherein the cannula further comprises a tapered portion proximate the distal end of the cannula.

38. (Original) The cannula of Claim 22, further comprising a recess at the distal end of the cannula and configured to receive a guide-member.

39. (Original) The cannula of Claim 38, further comprising a guide-member embedded in the recess.

40. (Original) The cannula of Claim 39, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

41. (Original) The cannula of Claim 22, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

42. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates; and

the cannula of Claim 41 fluidly linking the pump to the patient's vasculature.

43. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates;

an inflow conduit fluidly coupled to the pump and configured to direct blood to the pump from a first vascular site; and

the cannula of Claim 22 fluidly linking the pump to a second vascular site.

44. (Original) A percutaneous cannula for discharging blood within a patient's vasculature, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough; and

a transition portion having a helical shape and including a plurality of axially spaced discharge apertures, the transition portion being configured to direct blood from the blood flow lumen into a blood vessel generally proximally and toward the center of the transition portion when applied to the patient.

45. (Original) The cannula of Claim 44, wherein substantially all of the discharge apertures are oriented toward the main cannula portion.

46. (Original) The cannula of Claim 45, wherein substantially all of the discharge apertures are oriented toward a central portion of the blood vessel.

47. (Original) The cannula of Claim 44, wherein the helical shaped portion is collapsible to a non-helical shape for insertion of the cannula into the blood vessel.

48. (Original) The cannula of Claim 44, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

49. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates; and

the cannula of Claim 48 fluidly linking the pump to the patient's vasculature.

50. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates;

an inflow conduit fluidly coupled to the pump and configured to direct blood to the pump from a first vascular site; and

the cannula of Claim 44 fluidly linking the pump to a second vascular site.

51. (Original) A percutaneous cannula for discharging blood within a patient's vasculature, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough; and

a transition portion comprising an arcuate portion defined by a curve subtending an angle of more than 180 degrees and a discharge opening providing fluid communication between the blood flow lumen and a blood vessel when applied to the patient, whereby the transition portion is configured to discharge blood through the discharge opening away from an adjacent blood vessel wall.

52. (Original) The cannula of Claim 51, wherein the discharge opening is oriented toward the main cannula portion.

53. (Original) The cannula of Claim 51, wherein the arcuate portion is collapsible to a non-arcuate shape for insertion of the cannula into the blood vessel.

54. (Original) The cannula of Claim 51, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

55. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates; and

the cannula of Claim 54 fluidly linking the pump to the patient's vasculature.

56. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates;

an inflow conduit fluidly coupled to the pump and configured to direct blood to the pump from a first vascular site; and

the cannula of Claim 51 fluidly linking the pump to a second vascular site.

57. (Original) A percutaneous cannula for discharging blood within a patient's vasculature, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough;

a transition portion at a distal end of the cannula comprising:

a discharge opening; and

an outflow portion extending to the opening and defining a curvilinear portion, the curvilinear portion configured to engage opposite walls of a blood vessel when applied to the patient.

58. (Original) The cannula of Claim 57, wherein the outflow portion comprises an arcuate portion defined by a first curve subtending an angle of at least 180 degrees and a second curve defined by an angle sufficient to direct blood flowing through the discharge opening in a substantially proximal direction.

59. (Original) The cannula of Claim 57, wherein the outflow portion extends along an axis generally parallel to the main cannula portion.

60. (Original) The cannula of Claim 57, wherein the cannula is configured to prevent blood flow through the discharge opening from immediately discharging against the opposite walls of the blood vessel.

61. (Original) The cannula of Claim 57, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

62. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates; and

the cannula of Claim 61 fluidly linking the pump to the patient's vasculature.

63. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates;

an inflow conduit fluidly coupled to the pump and configured to direct blood to the pump from a first vascular site; and

the cannula of Claim 57 fluidly linking the pump to a second vascular site.

64. (Original) A percutaneous cannula for discharging blood within a patient's vasculature, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough; and

a tip portion comprising:

a lateral discharge opening near a distal end of the cannula;

a diverter wall extending into the blood flow lumen to divert some of the blood in the blood flow lumen away from the lateral discharge opening; and

a redirecting surface extending across the distal end of the blood flow lumen configured to direct blood through the lateral discharge opening.

65. (Original) The cannula of Claim 64, wherein the redirecting surface comprises a curved surface.

66. (Original) The cannula of Claim 64, wherein the diverter wall and a wall of the tip portion define a constricted passage with a semi-circular cross-section.

67. (Original) The cannula of Claim 64, wherein the diverter wall and a wall of the tip portion define a constricted passage with a crescent cross-section.

68. (Original) The cannula of Claim 64, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

69. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates; and

the cannula of Claim 68 fluidly linking the pump to the patient's vasculature.

70. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates;

an inflow conduit fluidly coupled to the pump and configured to direct blood to the pump from a first vascular site; and

the cannula of Claim 64 fluidly linking the pump to a second vascular site.

71. (Original) A percutaneous cannula for discharging blood within a patient's vasculature, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough; and

a tip portion comprising:

a funnel portion at a distal end of the blood flow lumen;

an outlet at the distal end of the funnel portion;

a surface extending across but spaced from the outlet, the surface configured to directed blood flow through a discharge opening.

72. (Original) The cannula of Claim 71, wherein the tip portion further comprises a plurality of discharge openings.

73. (Original) The cannula of Claim 71, wherein the tip portion further comprises a guidewire lumen extending between the surface and the distal end of the cannula.

74. (Original) The cannula of Claim 73, further comprising sealing means configured to minimize the flow of blood through the guidewire lumen when the cannula is in operation.

75. (Original) The cannula of Claim 74, further comprising a valve located in the guidewire lumen.

76. (Original) The cannula of Claim 74, further comprising a plug located in the guidewire lumen.

77. (Original) The cannula of Claim 71, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

78. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates; and

the cannula of Claim 77 fluidly linking the pump to the patient's vasculature.

79. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates;

an inflow conduit fluidly coupled to the pump and configured to direct blood to the pump from a first vascular site; and

the cannula of Claim 71 fluidly linking the pump to a second vascular site.

80. (Original) A percutaneous cannula for directing blood into the vasculature of a patient, the cannula comprising:

a main cannula portion comprising a blood flow lumen extending therethrough, the main cannula portion defining an outer perimeter near the distal end; and

a tip portion comprising:

an enlarged portion having an outer perimeter greater than the outer perimeter of the main cannula portion at its distal end; and

a plurality of apertures located on a generally proximally facing surface of the enlarged portion.

81. (Original) The cannula of Claim 80, wherein the enlarged portion comprises a generally spherical shape.

82. (Original) The cannula of Claim 80, wherein blood flow exiting the distal end of the cannula is redirected by the tip portion to substantially prevent blood discharging from the blood flow lumen through the apertures from directly impacting upon the wall of the blood vessel.

83. (Original) The cannula of Claim 80, wherein the blood flow lumen comprises a first blood flow lumen and wherein the main cannula portion further comprises a second blood flow lumen through which blood can be withdrawn from the vasculature.

84. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates; and

the cannula of Claim 83 fluidly linking the pump to the patient's vasculature.

85. (Original) An extracardiac pumping system for supplementing blood circulation in a patient, the extracardiac system comprising:

a pump configured to pump blood at subcardiac flow rates;

an inflow conduit fluidly coupled to the pump and configured to direct blood to the pump from a first vascular site; and

the cannula of Claim 80 fluidly linking the pump to a second vascular site.